Quarterly Progress Report:
Project Number and Title: 3.5 Prevention of Stress-Induced Failures of Prestressed Concrete Crossties of the Railroad Track Structure
Research Area: New Systems for Longevity and Constructability
PI: *Moochul Shin and Western New England University*
Co-PI(s): *ChangHoon Lee and Western New England University*
Reporting Period: ***7/1/2021~9/30/2021***
Submission Date: *9/30/2021*

Overview: (Please answer each question individually)

During the reporting period, the WNEU research team has been working mostly on Tasks 3, and 4.

- With three different prestressing tendons (smooth, shallow indentation, and deeper indentation), the compression damage upon prestressing release was measured in terms of the radius along the longitudinal axis. (See Figure 1).
- The greatest damage in terms of the damage radius due to compression occurs about half inches inward from the end of the crossties per prestressing tendon.
- The deeper indentation prestressing wire shows the largest damage radius among the three indentation types and most of the damage are concentrated within about 1 in of the prestressed concrete crossties. (see Figure 2). This implies that the developed ECMs can be applied to the last few inches in the railroad crossties.

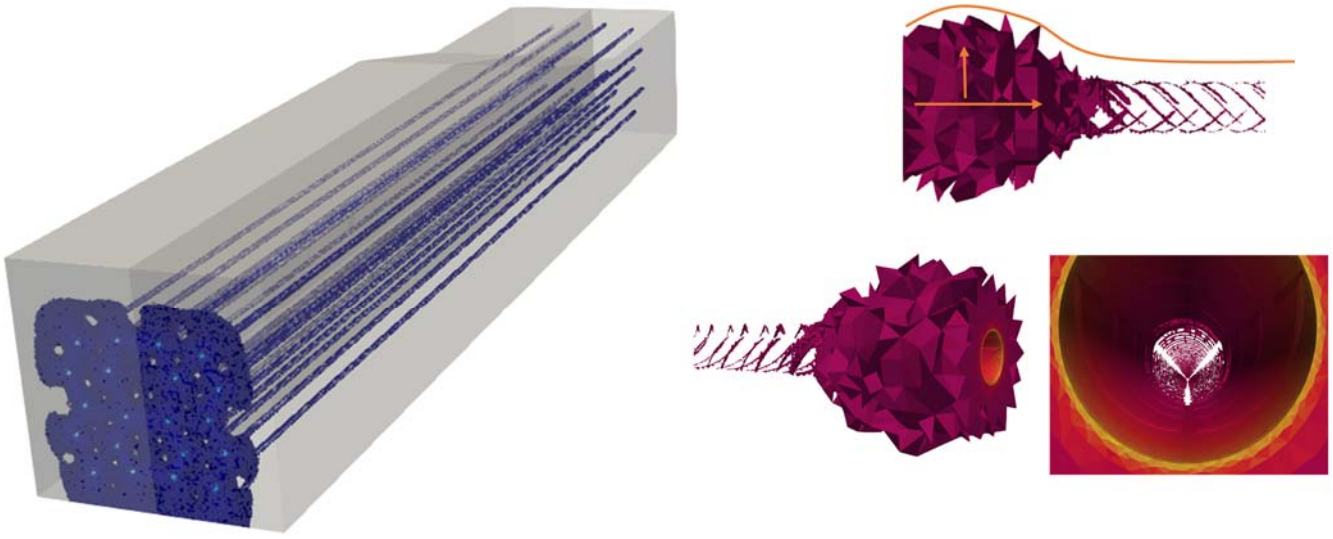

Figure.1 (a) Damage of Prestressed concrete crosstie upon prestressing release and (b) the compression damage along the length and radius

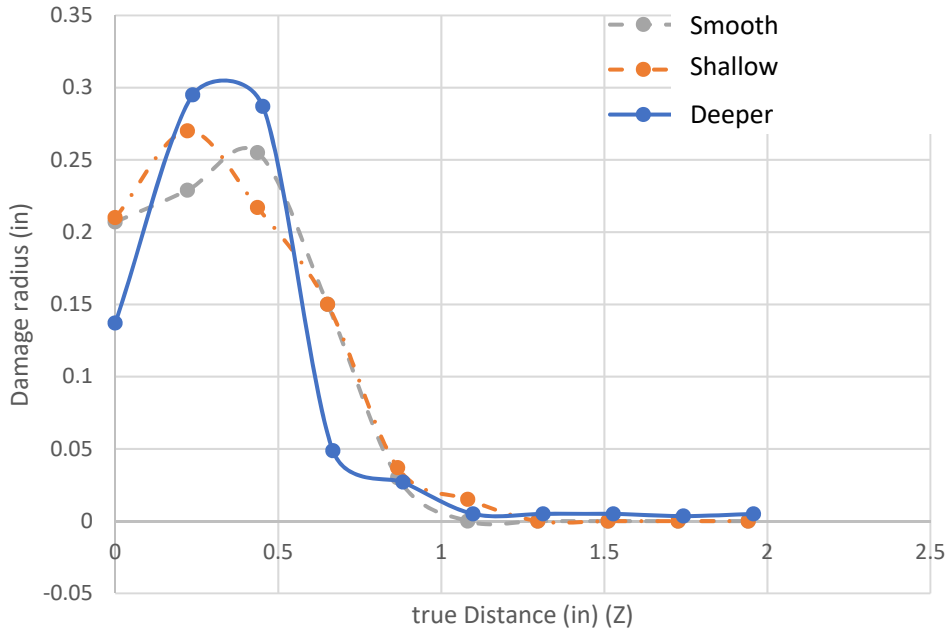

Figure 2. Damage radius with respect to the longitudinal length (true distance from the end of the crossties).

Table 1: Task Progress			
Task Number	**Start Date**	**End Date**	**% Complete**
Task 1: 3D FE Models	09/01/2018	12/30/2020	99 %
Task 2: 3D FE Models on HPC	03/01/2019	5/31/2021	99 %
Task 3: Crosstie Models	06/01/2020	09/30/2021	90 %
Task 4: Introduction of Engineered Cementitious Materials	12/01/2018	05/31/2021	90 %
Overall Project:	09/01/2018	09/30/2021	90%

Table 2: Budget Progress		
Project Budget	**Spend – Project to Date**	**% Project to Date***
$385,000	$342,652 to 8/31/2021	89.0 % to 5/31/2021

Include the date the budget is current to.

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events				
Title	**Event**	**Type**	**Location**	**Date(s)**
n/a				

Table 4: Publications and Submitted Papers and Reports				
Type	**Title**	**Citation**	**Date**	**Status**
n/a				

Participants and Collaborators:

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members			
Individual Name	**Email Address**	**Department**	**Role in Research**
Moochul Shin	moochul.shin@wne.edu	Civil and Environmental Engineering	Leading Tasks 2 and 3
Chang Hoon Lee	changhoon.lee@wne.edu	Civil & Environmental Engineering	Leading Task 4.

Table 6: Student Participants during the reporting period				
Student Name	**Email Address**	**Class**	**Major**	**Role in research**
Georgii Tifaniuk		Senior	Civil Engineering	Experimental Testing
Evan Blake		Junior	Civil Engineering	Experimental Testing
Christa-Elizabeth Cicerone		Junior	Civil Engineering	Experimental Testing
Brian Leclair		Junior	Civil Engineering	Experimental Testing
Daniel Doyle		Junior	Civil Engineering	Experimental Testing
Archer Parker		Junior	Civil Engineering	Experimental Testing

Table 7: Student Graduates			
Student Name	**Role in Research**	**Degree**	**Graduation Date**
n/a			

Table 8: Research Project Collaborators during the reporting period						
Organization	**Location**	**Contribution to the Project**				
		Financial Support	**In-Kind Support**	**Facilities**	**Collaborative Research**	**Personnel Exchanges**
National Center for Supercomputing Applications	Urbana, IL		x			
Texas Advanced Computing Center	Austin, TX			x		

The in-house parallel algorithm code was mainly developed by Dr. Kwack (currently at Argonne National Laboratory) when he was a staff member of the Blue Waters sustained-petascale computing project, which is supported by the National Science Foundation (awards OCI-0725070 and ACI-1238993) and the State of Illinois. In addition, this work partially used the XSEDE resource – Stampede2-TACC through allocation #MSS180002.

Table 9: Other Collaborators			
Collaborator Name and Title	**Contact Information**	**Organization and Department**	**Contribution to Research**
JaeHyuk Kwack	jkwack@anl.gov	National Center for Supercomputing Applications (currently at Argonne National Laboratory)	Technical support and advice for high performance computing
Hailing Yu	Hailing_yu@yahoo.com	Volpe Center (currently at STV)	Technical champion

Who is the Technical Champion for this project?
Name: Hailing Yu
Title: Mechanical Engineer (Engineering Specialist)
Organization: Volpe center (currently at STV)
Location (City & State): Cambridge, MA (Boston, MA)
Email Address: hailing.yu@dot.gov (hailing_yu@yahoo.com)

Changes:

New members have joined the research team. The WNE team has been working with new undergraduate students to conduct the research. The research team takes some time to train these new students.

Georgii Tifaniuk, senior in Civil engineering, will be not be participating in the research activities temporarily.

The 6 month extension on the high-performance computer (HPC) - Stampede2-TACC through allocation #MSS180002 has been granted.

Planned Activities:

1. Large-scale prestressed concrete crosstie models will be further developed with multiple wires in order to investigate the overall responses using the HPC.

2. The research will be asking a year extension on Phase I of the project.

3. The research team will be monitoring the safety guidelines of the lab environments.

4. The research team will finalize the development of ECM for the railroad crossties. The use of high volume paste can be a potential risk for shrinkage crack despite denser microstructure. The research team investigates the performance of concrete with respect to combinations of the paste volume and the size distribution of aggregates.

5. The research team will be developing fiber-reinforced ECMs to enhance the properties of railroad crossties (Phase II).